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<b>(21) International Application Number:</b> PCT/CA94/00521 <b>(22) International Filing Date:</b> 20 September 1994 (20.09.94) <b>(30) Priority Data:</b> 08/123,095 20 September 1993 (20.09.93) US <b>(71)(72) Applicant and Inventor:</b> BROWN, John, E. [CA/CA]; 8 Northwood Avenue, St. Catharines, Ontario L2M 4J6 (CA). <b>(74) Agent:</b> JOHNSTON, N., Malcolm, S.; Malcolm Johnston & Associates, Suite 505, 133 Richmond Street West, Toronto, Ontario M5H 2L3 (CA).		<b>(81) Designated States:</b> AM, AU, BB, BG, BR, BY, CA, CN, CZ, EE, FI, GE, HU, JP, KG, KP, KR, KZ, LK, LR, LT, LV, MD, MG, MN, NO, NZ, PL, RO, RU, SI, SK, TJ, TT, UA, UZ, VN, European patent (AT, BE, CH, DE, DK, ES, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, ML, MR, NE, SN, TD, TG), ARIPO patent (KE, MW, SD, SZ).  <b>Published</b> <i>With international search report.</i>
<b>(54) Title:</b> FRANGIBLE FIREARM BULLETS AND CARTRIDGES INCLUDING SAME		
<b>(57) Abstract</b>  A frangible bullet which is ruptured on impact, is made of Bi. The bismuth can be alloyed with tin, antimony or zinc. Possible Bi amounts: at least 90 %, at least 95 %, at least 98 % or at least 99 %. The bullet has a Cu jacket having a thickness of less than 1 mm and greater than 0.1 mm, in particular a thickness of 0.5 mm. Manufacturing method: the bullet is formed by casting, spin moulding, dropping or punching.		

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FRANGIBLE FIREARM BULLETS  
AND CARTRIDGES INCLUDING SAME

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BACKGROUND OF THE INVENTION

Field of the Invention

The present invention relates to improved projectiles including bullets  
10 for firearms, and cartridges including same.

Description of the Background Art

Many bullets for firearms are formed totally or partially from lead. The  
15 density of lead provides bullets made therefrom with excellent ballistic  
efficiency. Additionally, the deformability of lead typically results in  
expansion of the bullet and "mushrooming" thereof on impact, giving the  
bullet increased "stopping" power. Jacketed bullets have an outer layer of  
copper or other material to prevent barrel damage or fouling. The cores of  
20 jacketed bullets often are made of lead to provide the bullet with acceptable  
ballistic properties.

Lead core jacketed bullets can be made in "soft point" or "hollow point"  
to facilitate "mushrooming" of the bullet, and maximize its stopping power.

Jacketed bullet cores also can be made of steel to provide the bullet  
25 with armor piercing capability.

Whether a bullet is solid lead or some form of jacketed construction,  
a principle goal heretofore in the art has been to provide bullets which remain  
in one piece after impact because of the perceived reduction in penetration and  
"stopping" power which would result from bullets which broke apart on  
30 impact. However, bullets which remain in one piece on impact often ricochet  
upon striking a hard surface. Bullets which ricochet are undesirable for use  
by law enforcement officers, because of the increased risk that innocent

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bystanders might be injured or killed. Additionally, ricocheting bullets or bullets which penetrate hard objects are undesirable for use by security personnel at nuclear facilities, because of the risk of damage to sensitive nuclear equipment.

- 5           There is thus a need in the art for non-ricocheting bullets and bullets which do not penetrate deeply into hard objects.

### SUMMARY OF THE INVENTION

- 10           In accordance with one aspect of the present invention, a projectile is provided which comprises a frangible firearm bullet, at least a principal portion of which is formed of a one-piece element primarily made up of bismuth.

- 15           In accordance with another aspect of the invention, a firearm cartridge is provided comprising a casing, a propellant contained within the casing, means for igniting the propellant, and a frangible firearm bullet, at least a principal portion of which is formed of a one-piece element having a continuous all-metal structure containing bismuth.

### BRIEF DESCRIPTION OF THE DRAWINGS

- 20           Fig. 1 is a partly schematic cross-sectional view of a firearm cartridge including a frangible, one-piece bullet containing bismuth according to one embodiment of the present invention.

          Fig. 2 is a partly schematic cross-sectional view of a frangible, one-piece, bismuth-containing shotgun slug according to another embodiment.

- 25           Fig. 3 is a partly schematic cross-sectional view of a frangible, jacketed, bismuth-containing bullet according to still another embodiment.

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### DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

It has surprisingly been discovered that high bismuth content bullets perform ballistically similar to lead bullets when shot from a firearm, but are frangible (i.e., break up) on impact with a hard surface, thus reducing or eliminating ricocheting off the hard surface or deep penetration of the hard surface. This is surprising, because it could not have been predicted that a frangible bismuth bullet would survive the extreme stress applied to the bullet during the explosion resulting from firing of the gun, and the stress from the bullet being forced through the grooves of the gun barrel during the explosion, while maintaining its physical integrity during flight and performing with substantially the ballistic accuracy and consistency of lead.

Fig. 1 illustrates a firearm cartridge including a casing 10 which can, for example, be made of brass. Within casing 10 is an explosive propellant in the form of powder 12. The propellant 12 is ignited by means of a primer 14 which is actuated when struck by the firing pin of a firearm (not shown).

Held within neck 16 of casing 10 is a bismuth-containing bullet 18 according to one embodiment of the present invention. Bullet 18 shown in Fig. 1 is made in one piece with an all-metal continuous structure formed by any suitable method such as casting. However, the invention is also applicable to multi-piece frangible bullets, jacketed frangible bullets, and the like.

Applicant has discovered that bismuth is an excellent material for use in the manufacture of frangible firearm bullets of any useful size. For example, the invention is applicable to bullets in the size range of from about .22 caliber up to about .50 caliber or higher for pistols and rifles, up to about 10 gauge slugs for shotguns, and up to about 16 inch for cannons. Fig. 2 shows a one-piece, bismuth-containing, frangible shotgun slug 19 according to one embodiment.

In Fig. 3, the bullet 20 is made up of a frangible, one-piece, bismuth-containing core element 32 surrounded by a barrel groove-gripping soft jacket

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24, which can be of any suitable metal or non-metal material such as copper. Soft jacket 24 improves accuracy at higher velocities by deforming into barrel rifling grooves. Jacket 24 is sufficiently thin so as to break apart on impact, e.g., less than about 1 mm and greater than about 0.1 mm, preferably about 5 0.5 mm or less. Exposure of nose 34 of bismuth-containing core 32 facilitates breakup of the jacketed bullet on impact.

The bismuth-containing bullets in accordance with the present invention are formed by casting, spin molding, dropping, punching or in any other suitable manner, and can be made from substantially pure bismuth, or high 10 bismuth content alloy.

Bismuth also have an advantage in not being a precious metal. Bismuth can thus be used in substantially pure form, or alloyed with other non-precious metals, to form non-poisonous frangible bullets. In preferred embodiments, frangible bullets according to the invention are primarily made up of bismuth. 15 In particularly preferred embodiments, the bismuth-containing frangible bullets in accordance with the present invention contain at least about 90% bismuth by weight. In more preferred embodiments, the bismuth-containing frangible bullets contain at least about 92%, 94%, 96%, 98% or 99% by weight bismuth.

20 High bismuth-content frangible bullets can be made to perform substantially as well ballistically as corresponding lead bullets.

In particularly preferred embodiments, pure bismuth and nearly pure bismuth alloys are utilized to form brittle frangible bullets which readily break apart or shatter upon impact with a hard or rigid surface. The shattering 25 causes the bullet to lose its energy. This greatly reduces dangerous ricochets and limits the bullet's ability to penetrate or pass through solid objects and harm unintended targets. For example, frangible bullets in accordance with the present invention having a size from about .22 to about .50 caliber will

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shatter or fail to penetrate 1/16" mild steel sheet stock at angles greater than 45°, without substantial ricocheting.

Since many modifications, variations and changes in detail may be made to the described embodiments, it is intended that all matter in the  
5 foregoing description and shown in the accompanying drawings be interpreted as illustrative and not in a limiting sense.

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CLAIMS:

1. A projectile comprising a frangible firearm bullet composed primarily of bismuth.
- 5 2. The projectile of Claim 1 wherein at least a principle portion of said bullet is formed of a frangible, one-piece element, having a continuous all-metal, structure primarily made up of bismuth.
- 10 3. The projectile of Claim 2, wherein said bullet is of a size in the range of from about .22 caliber to about 16 inch caliber.
4. The projectile of Claim 2, wherein said one-piece element further comprises tin, antimony, zinc or a mixture thereof.
- 15 5. The projectile of Claim 2, wherein said one-piece element is formed by casting, spin molding, dropping or punching.
6. The projectile of Claim 2, wherein said one-piece element contains at least about 90% by weight or more bismuth.
- 20 7. The projectile of Claim 2, wherein said one-piece element contains at least about 95% by weight or more bismuth.
- 25 8. The projectile of Claim 2, wherein said one-piece element contains at least about 98% by weight or more bismuth.
9. The projectile of Claim 2, wherein said one-piece element contains at least about 99% by weight or more bismuth.



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10. The projectile of Claim 2, wherein said bullet is of a size in the range of from about .22 caliber to about .50 caliber.
11. The projectile of Claim 10, wherein said bullet shatters upon impacting  
5 1/16" mild steel sheet stock at angles greater than 45°.
12. The projectile of Claim 2, wherein said one-piece element is a bullet core, which bullet core is surrounded by a jacket.
- 10 13. The projectile of Claim 12, wherein said jacket contains copper.
14. The projectile of Claim 12, wherein the jacket is less than about 1 mm in thickness and greater than about 0.1 mm in thickness.
- 15 15. The projectile of Claim 14, wherein said jacket is about 0.5 mm or less in thickness.
16. A firearm cartridge comprising:
- 20 (a) a casing;
- (b) a propellant contained within said casing;
- (c) means for igniting said propellant; and
- (d) a frangible firearm bullet, at least a principal portion of said bullet being formed of a one-piece element having a continuous all-metal structure primarily made up of bismuth.
- 25 17. The cartridge of Claim 16, wherein said one-piece element is a bullet core, which bullet core is surrounded by a jacket.

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18. The cartridge of Claim 17, wherein said jacket is less than about 1 mm in thickness and greater than about 0.1 mm in thickness.

19. The cartridge of Claim 18, wherein said jacket is about 0.5 mm or less  
5 in thickness.

20. The cartridge of Claim 18, wherein said jacket contains copper.

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FIG.1.

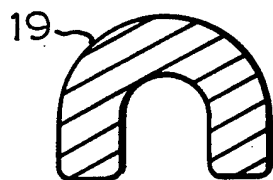


FIG.2.

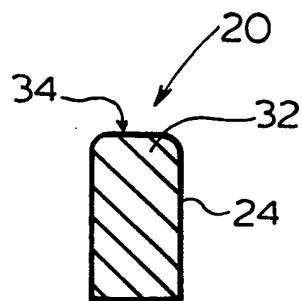


FIG.3.

## INTERNATIONAL SEARCH REPORT

International Application No

PCT/CA 94/00521

**A. CLASSIFICATION OF SUBJECT MATTER**  
IPC 6 F42B12/74

According to International Patent Classification (IPC) or to both national classification and IPC

**B. FIELDS SEARCHED**Minimum documentation searched (classification system followed by classification symbols)  
IPC 6 F42B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO,A,92 08097 (J. BROWN) 14 May 1992 see the whole document -----	1-20

☐ Further documents are listed in the continuation of box C.☒ Patent family members are listed in annex.**\* Special categories of cited documents :**

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Date of the actual completion of the international search

8 November 1994

Date of mailing of the international search report

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**PCT/CA 94/00521**

Form PCT/ISA/210 (patent family annex) (July 1992)

**DERWENT-ACC-NO:** 1995-139684**DERWENT-WEEK:** 199518*COPYRIGHT 2007 DERWENT INFORMATION LTD*

**TITLE:** Frangible firearm bullet and cartridge - uses high content bismuth bullet, which shatters on impact with a hard surface, reducing the risk of ricochet

**INVENTOR:** BROWN, J E**PATENT-ASSIGNEE:** BROWN J E[BROWI]

**PRIORITY-DATA:** 1993US-0123095 (September 20, 1993)

**PATENT-FAMILY:**

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WO 9508748 A1	March 30, 1995	E	013	F42B 012/74
AU 9477359 A	April 10, 1995	N/A	000	F42B 012/74

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 DE DK ES FR GB GR IE IT KE LU  
 MC MW NL OA PT SD SE SZ

**CITED-DOCUMENTS:** WO 9208097

**APPLICATION-DATA:**

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WO 9508748A1	N/A	1994WO- CA00521	September 20, 1994
AU 9477359A	N/A	1994AU- 0077359	September 20, 1994
AU 9477359A	Based on	WO 9508748	N/A

**INT-CL (IPC):** F42B012/74

**ABSTRACTED-PUB-NO:** WO 9508748A

**BASIC-ABSTRACT:**

A firearm cartridge comprises a casing (10) of, e. g. brass, contg. an explosive propellant powder (12) ignited by a primer (14) when struck by the firing pin of a firearm. Secured into the neck (16) of said casing (10) is a bullet (20) made from a one-piece core element (32) surrounded by a soft jacket (24) of, e.g. copper. The core element (32) is composed of from 90% to 88% bismuth together with tin, antimony, zinc or a mixture

thereof, and can be formed by casting, spin moulding, dropping or punching. The jacket (24) may have a thickness between 0.1 mm and 1.0 mm, preferably about 0.5 mm. The bullet is suitable for manufacture in the size range 0.22 to 0.5 calibre, and will shatter upon impacting mild steel sheet 0.062 inch thick at angles greater than 45 deg. . Projectiles up to 16 inch calibre may also be produced.

USE - Used in firearms where ricocheting may endanger innocent bystanders, or sensitive equipment.

ADVANTAGE - A frangible projectile having similar ballistic performance to lead bullets but disintegrates on striking a hard surface, thereby retaining the same stopping power with reduced risk of ricochet.

**CHOSEN-DRAWING:** Dwg.1/3

**TITLE-TERMS:** FRANGIBLE FIREARM BULLET  
CARTRIDGE HIGH CONTENT BISMUTH  
BULLET SHATTER IMPACT HARD  
SURFACE REDUCE RISK RICOCHET

**DERWENT-CLASS:** K03 Q79

**CPI-CODES:** K03-A01;

**SECONDARY-ACC-NO:**

**CPI Secondary Accession Numbers:** C1995-064547

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